The Use of Malaysia Ilmenite as Weighting Material In Drilling Mud

Ahmad Kamal bin Idris, Issham bin Ismail,
Ariff bin Othman, and Ha Kwong Tak

Department of Petroleum Engineering,
Faculty of Chemical and Natural Resources Engineering,
Universiti Teknologi Malaysia,
Jalan Semarak,
54100 Kuala Lumpur.

ABSTRACT

This paper discusses the prospect of utilising Malaysia ilmenite as weighting material in drilling mud. The discussion is based on laboratory experiments.

The performance of local ilmenite was compared to barite in a lignosulfonate mud system. The results showed that for a given mud density, ilmenite gave a lower solid content. Compared with barite, ilmenite gave a much higher yield point and gel strength, but there were little differences in apparent viscosity and plastic viscosity. Ilmenite was also found to give a higher API fluid loss than barite. In contrast, the fluid loss produced by ilmenite sample via the HP/HT filter press was found to be much lower compared to the barite sample.

The high yield point and gel strength of the mud which utilised local ilmenite as weighting material could be lowered by increasing the concentration of lignosulfonate in the mud. There was no indication of incompatibility of lignosulfonate in the mud system.

Based on this preliminary study, it was concluded that the local ilmenite has the potential to be used as weighting material in drilling mud.

This paper was presented by Issham Ismail at International Conference in Recent Advances in Materials and Mineral Resources '94 (RAMM'94), PARKROYAL Penang, on the 3rd-5th May 1994, in commemoration of the silver jubilee of Universiti Sains Malaysia.

INTRODUCTION

Barite has been widely used as the principal material for weighting muds. The current consumption for the material in the country is around 20,000 tonne/year and is locally produced (Ahmad Badaruddin, 1984). With the expected increase in drilling activities and dwindling reserves, barite supply may fall short in the foreseeable future. Thus, there is a need to look for an alternate weighting material.

Ilmenite, an iron-based mineral, has been proved to be an useful weighting material in drilling mud. Field tests utilising ilmenite as weighting material in the seawater/lignosulfonate mud systems had been carried out in the North Sea (Blomberg et al, 1984). Compared with barite, ilmenite was found to be capable of producing improved rheological properties, fewer fine particles, low attrition and limited need for water dilution or chemical conditioning (Simposium, 1985).

Malaysia has a large reserve of ilmenite. Ilmenite is recovered as a by-product from tin-ore processing. Currently, there is not much industrial use of this mineral in the country and only the high-graded ilmenite is exported overseas for the extraction of titanium (Ahmad Badaruddin, 1984).

This technical paper describes the laboratory studies on rheological properties of mud that utilised local ilmenite as weighting material. The performance of this material was then compared to barite in a lignosulfonate mud.

LABORATORY TEST

The raw ilmenite sample that was to be tested was ground to meet the API specification set forth for barite. Two types of freshwater lignosulfonate muds were prepared with the mud A utilising barite and mud B utilising local ilmenite as weighting agents. pH of the muds was maintained at 9.5 and range of density under study was from 12.0 ppg to 17.0 ppg.

Static fluid properties were measured by using the Rheometer. Amongst the properties measured were apparent viscosity, plastic viscosity, yield point and gel strength. The density of muds were measured by using a mud balance (Gatlin, 1960).

The fluid loss of each of the samples used were also tested by using the API Standard Filter Press and HP/HT Filter Press. Whilst the solid content of those samples were measured by using the conventional method.

All the tests were conducted according to the API standard procedures.

A suspension comprising of 10 grams of local ilmenite in 100 ml distilled water gave a pH of 3.9 - 4.0. It showed that ilmenite has been contaminated with acid. This was due to the fact that in the separation process, sulphuric acid was added as a floatation chemical for sulfide mineral removal and thus giving the ilmenite an acidic character.

THE EFFECTS OF ILMENITE ON MUD PROPERTIES

For a given mud density, the mud B had a lower solid content than mud A (Figure 1). Generally, this is due to the fact that ilmenite has a specific gravity of 4.4 whereas specific gravity of barite is in the range of 4.2 - 4.25. Thus less material is required to increase the mud weight. Lower solid-content fluids may decrease drilling time.

The apparent viscosity of mud B was found higher than mud A (Figure 2). As for plastic viscosity, at a lower mud density (ie. less than 14 ppg), the mud B gave a higher value than mud A. However, at a higher mud density (ie. greater than 14 ppg) it gave a lower value (Figure 3). This phenomenon might be attributed to : -

i) Particle size distribution of the weighting materials used.

ii) Solid content of the mud.

iii) Effect of the contaminated ions present in the ilmenite sample.

As compared with barite, ilmenite gave a much higher yield point (Figure 4) and gel strength (Figure 5). The main cause of the high yield point and gel strength was due to the contamination of ions present in the ilmenite sample and excessive NaOH added to maintain the pH at 9.5. Generally, contaminated ions can cause clays to flocculate badly via the complex electrical attractive repulsive balance between clays that dispersed in water. Here, the contaminants will drive the clay platelets together prior to flocculation. Eventually they will aggregate.

The API filter loss of mud B was found to be much higher than mud A, as shown in Figure 6. This might be due to the presence of bigger particles size of ilmenite and the contaminated ions that affected the hydration of clay and consequently caused flocculation and aggregation, all of which tend to increase the fluid loss. Generally, the degree of flocculation increases with the increase in temperature.

THE EFFECTS OF LIGNOSULFONATE CONCENTRATION ON MUD PROPERTIES

Lignosulfonate was added to a 15 ppg mud that used local ilmenite as weighting material. The results showed that as the concentration of lignosulfonate in the mud increased, the apparent viscosity, yield point and gel strength would decrease with no changes in plastic viscosity. These phenomenons were shown in Figure 7 to 10. There was no indication of incompatibility of lignosulfonate in the mud system.

Lignosulfonate is a complex polymer which has both positive and negative groups. They can act as a "thinner" to avoid clay flocculation because the electrically charged clays are neutralised by the positively charged portion of lignosulfonate. In this way, lignosulfonate prevents the clay from attraction and flocculation.

Lignosulfonate also acts as a filter loss control agent. Hence, the addition of lignosulfonate into mud also reduces the filter loss and mud cake thickness.

CONCLUSION

Based on this laboratory studies, the following conclusions can be made : -

1) Local ilmenite has the potential to be used as weighting material in drilling mud. Problems such as high yield point and gel strength can be controlled by adding lignosulfonate or other additives.

2) Compared with barite, local ilmenite gives a lower solid content. This is due to the higher specific gravity of ilmenite.

3) Ilmenite gives a much higher yield point and gel strength. However, it can be reduced by increasing the lignosulfonate concentration.

4) Compared with barite, the differences in apparent viscosity and plastic viscosity are very small.

5) Ilmenite gives a higher API filter loss than barite.

ACKNOWLEDGEMENT

The authors wish to thank the Department of Petroleum Engineering, Universiti Teknologi Malaysia and Malaysia Mining Corporation for the support and permission to publish this paper.

REFERENCES

1) Ahmad Badaruddin, *Personal Communication*,Mineral Processing Engineer, Malaysia Mining Corporation, Kuala Lumpur, 1984.

2) Blomberg, N.E. et. al.: "Evaluation of Ilmenite as Weighting Material In Drilling Fluids,"Society of Petroleum Technology (June,1984) 969-974.

3) Simposium, J.P.: "The Drilling Mud Dilemma - Recent Examples," Journal of Petroleum Technology (February,1985) 201-206.

4) Gatlin, C.: "Petroleum Engineering : Drilling and Well Completions," Prentice-Hall Inc., United States of America (1960) 70-93.

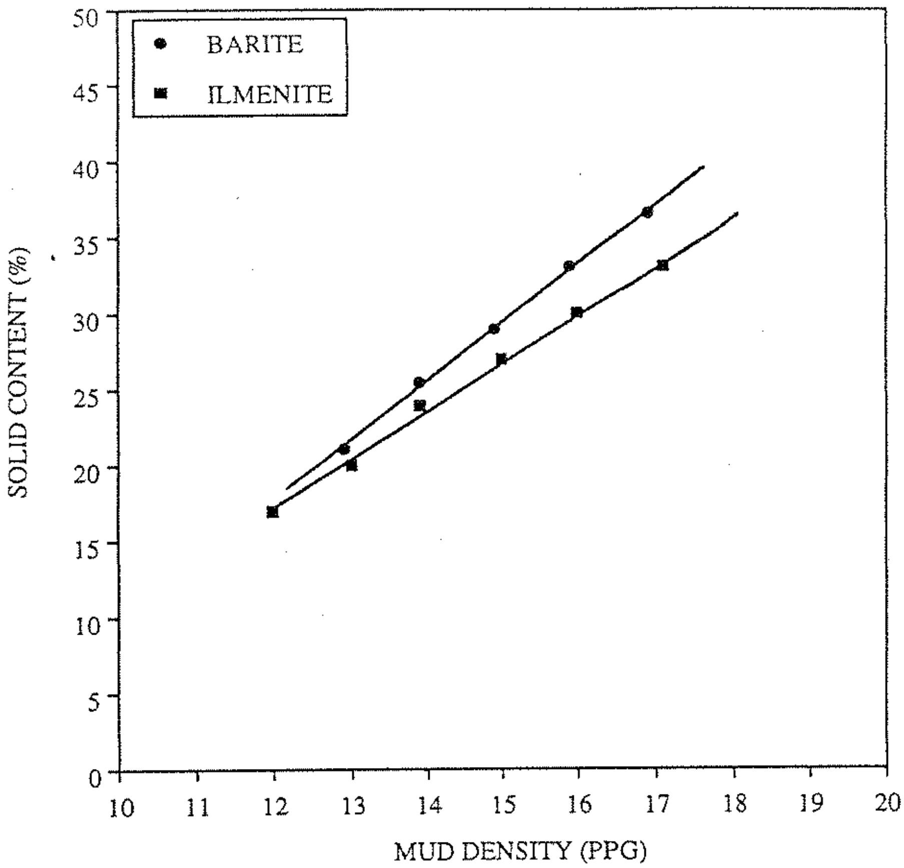

Figure 1 : Solid content versus mud density

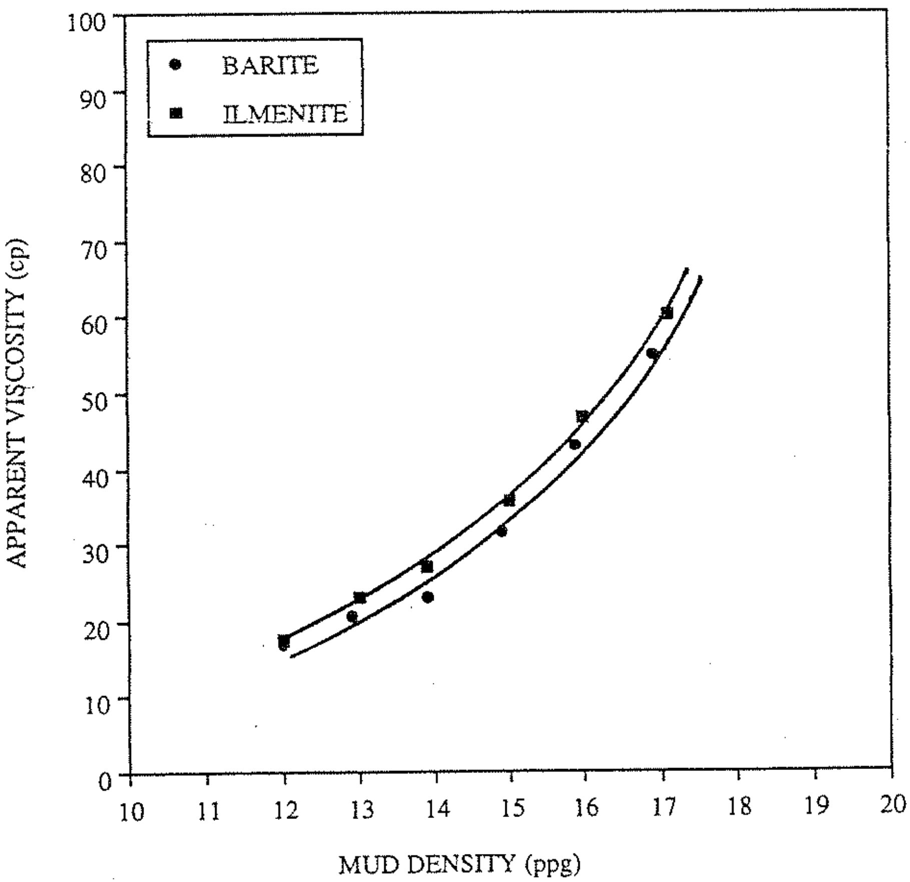

Figure 2 : Apparent viscosity versus mud density

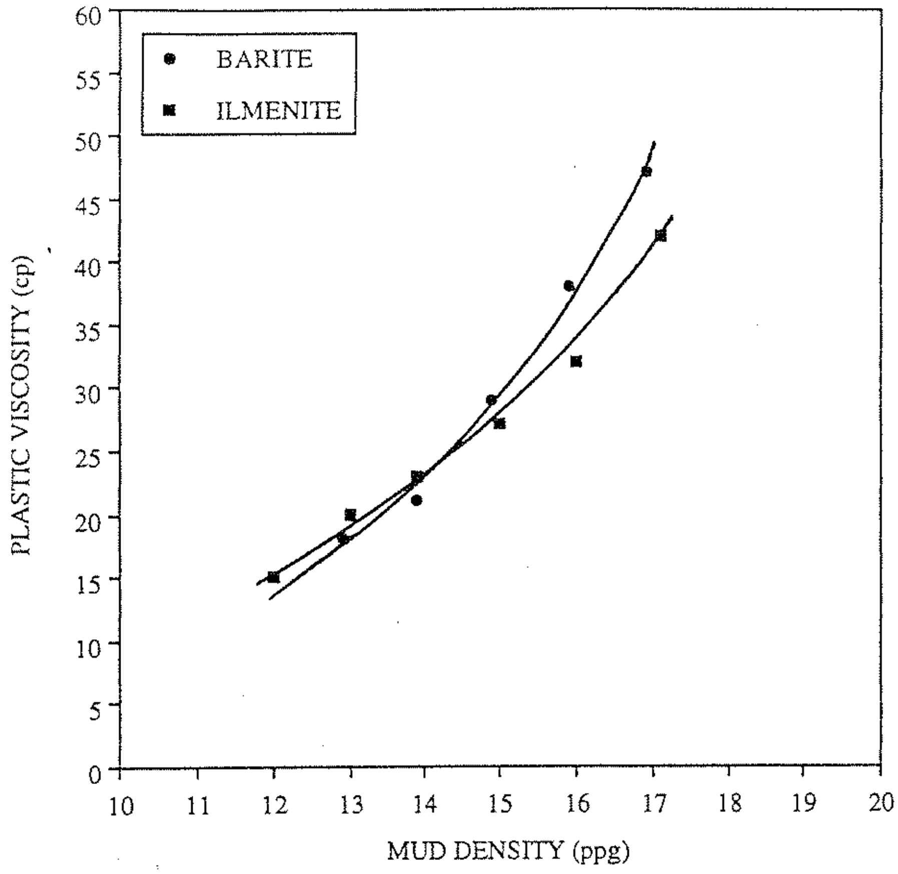

Figure 3 : Plastic viscosity versus mud density

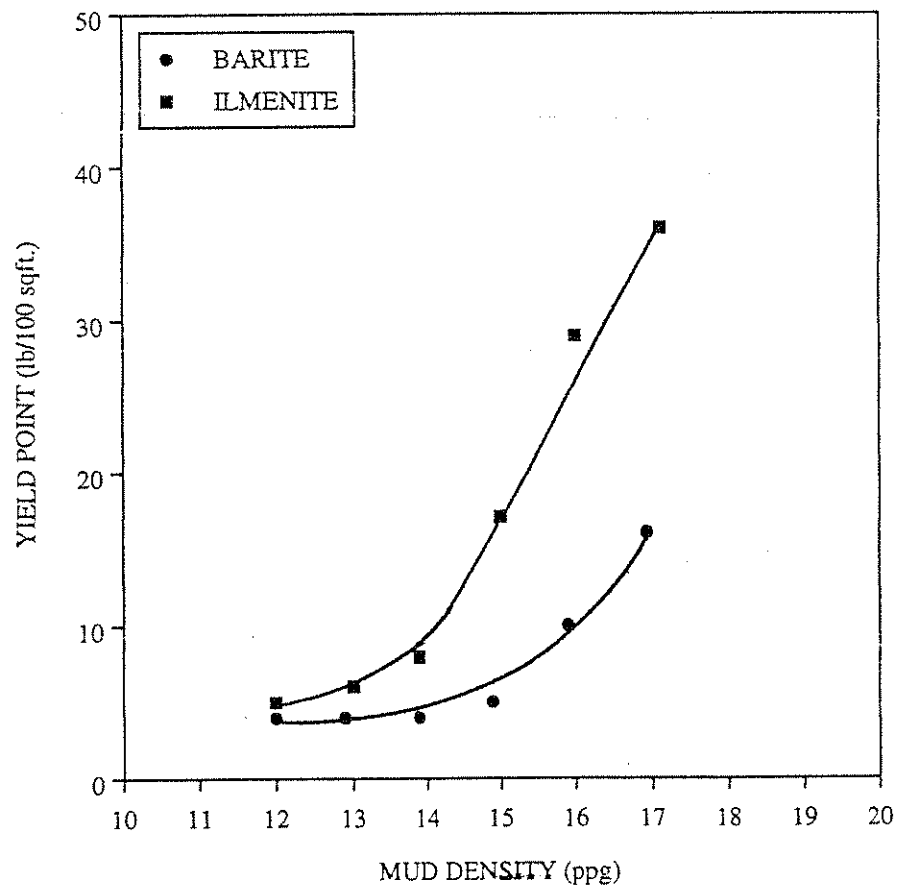

Figure 4 : Yield point versus mud density

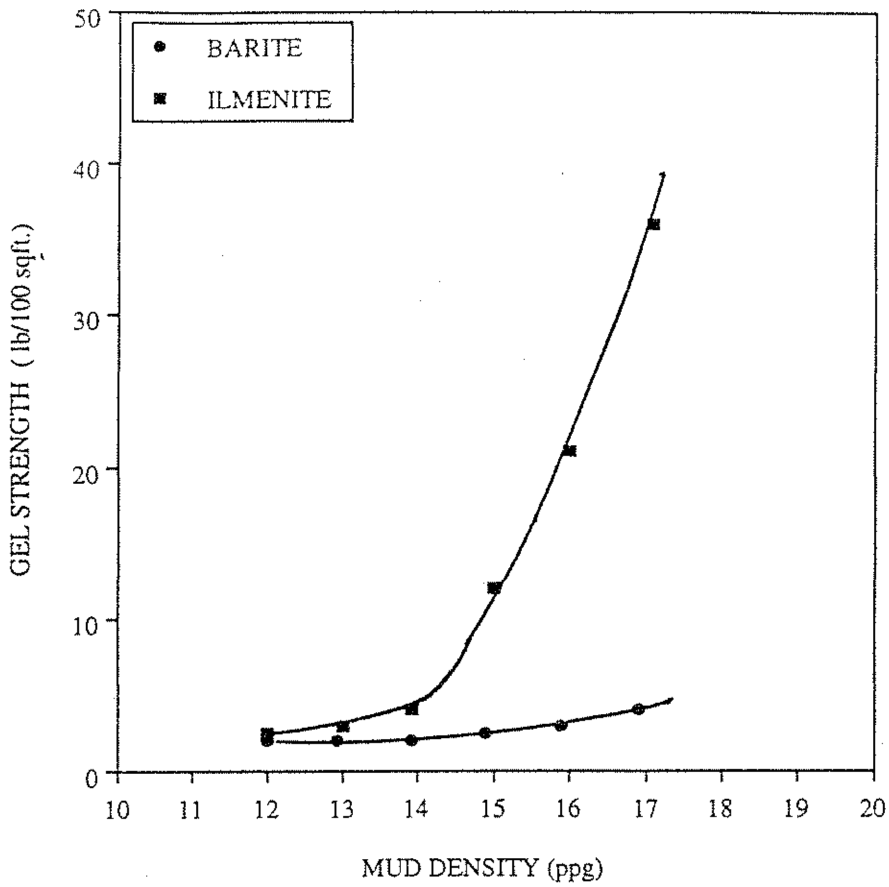

Figure 5 : Gel strength versus mud density

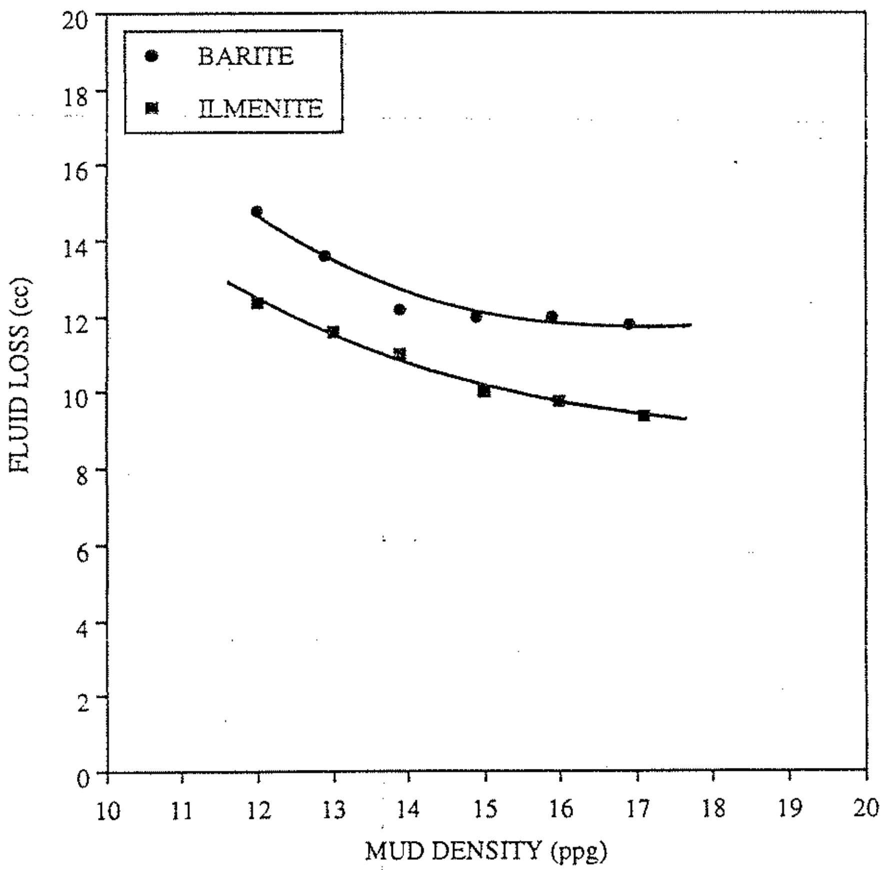

Figure 6 : Fluid loss versus mud density

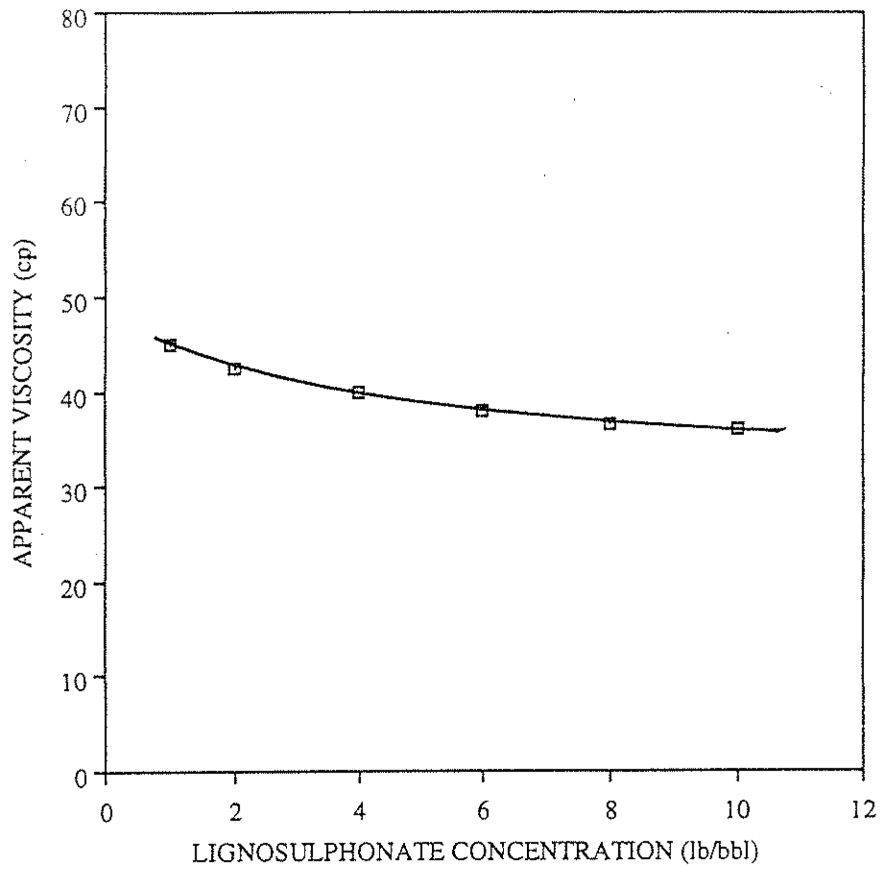

Figure 7 : Apparent viscosity vs lignosulphonate concentration

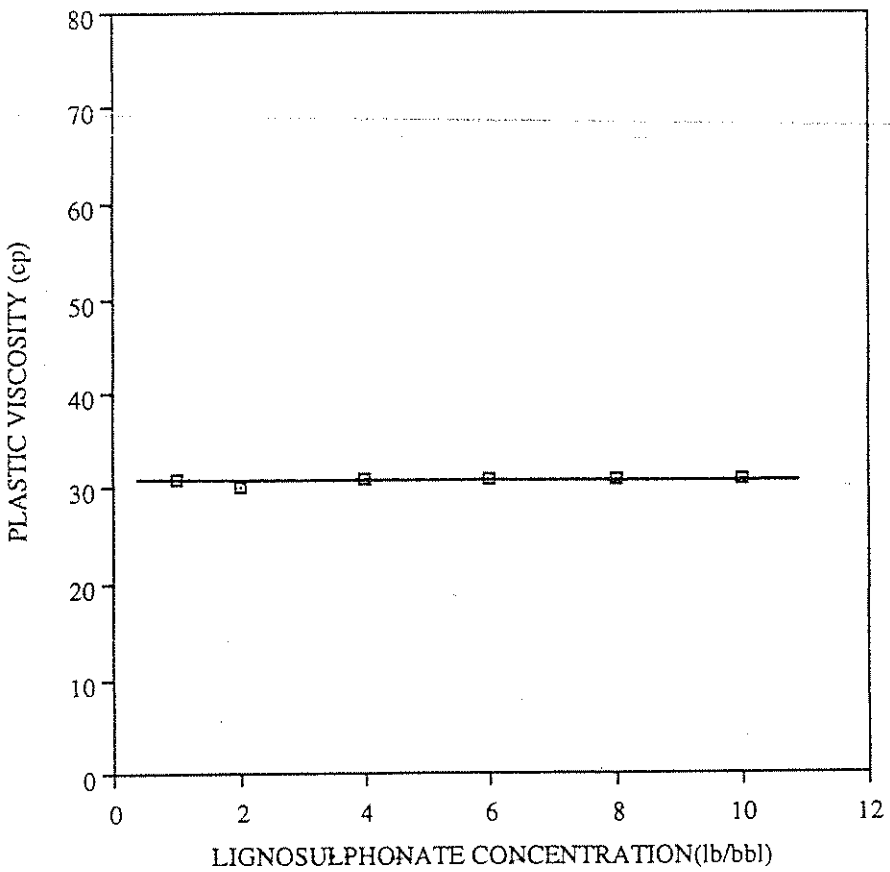

Figure 8 : Plastic viscosity versus lignosulphonate concentration

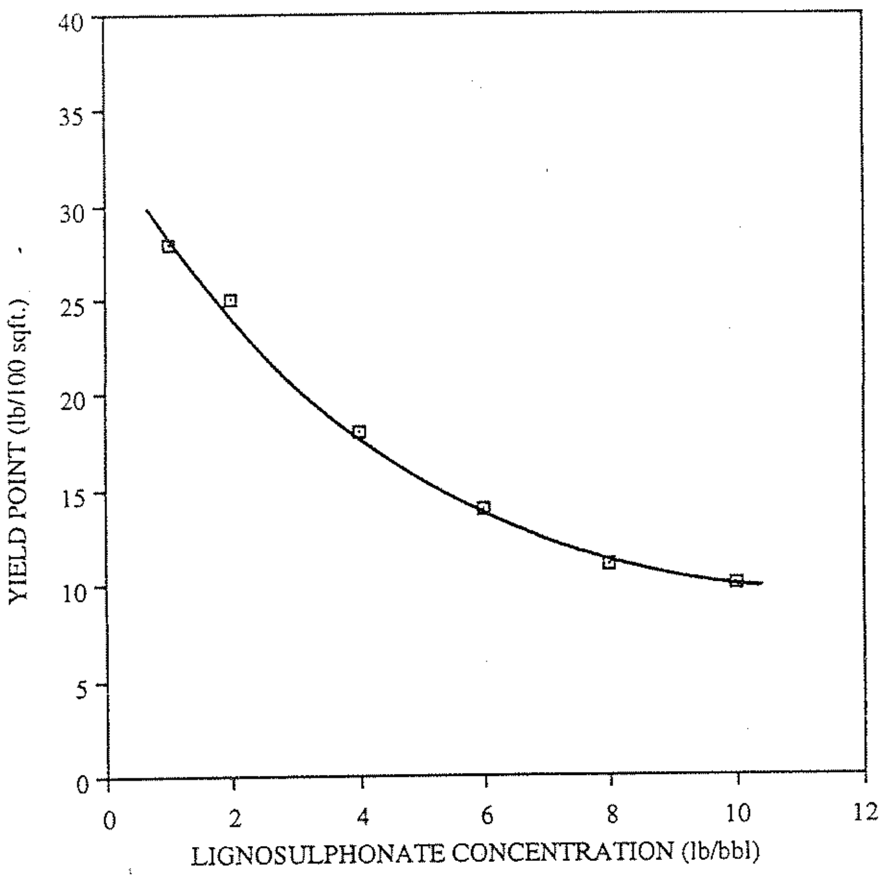

Figure 9 : Yield point versus lignosulphonate concentration

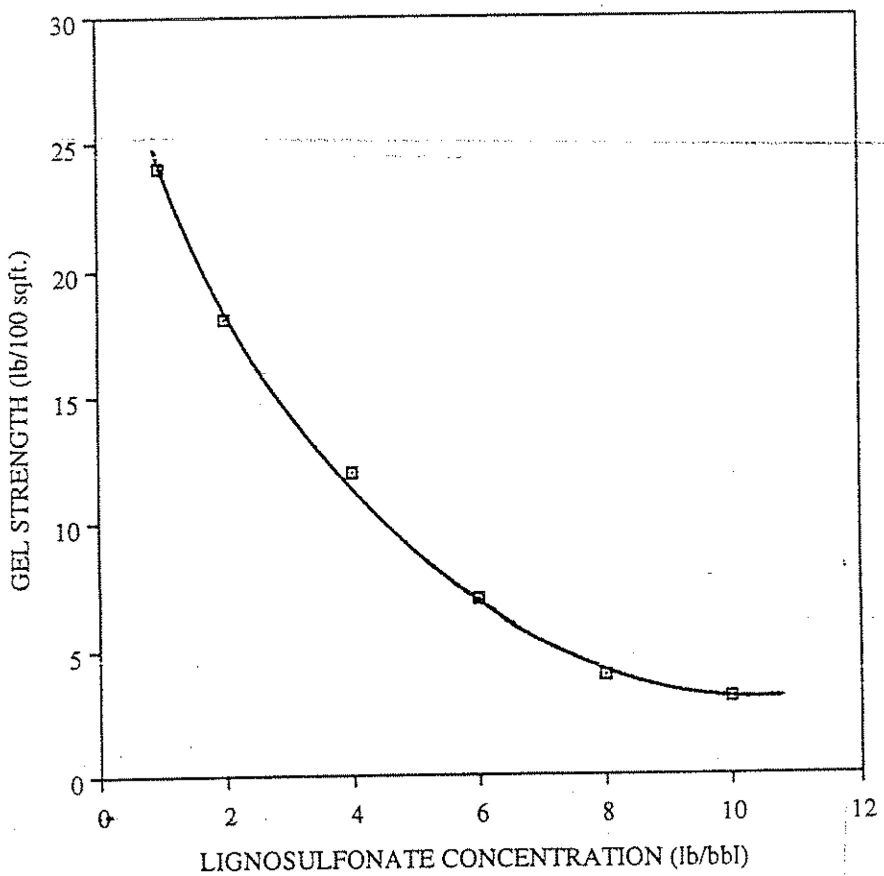

Figure 10 : Gel strength versus lignosulfonate concentration